Announcements

- Homework for tomorrow…

  Ch. 30: CQ 11, Probs. 28, 34, & 58

  CQ6: $I_a = I_d > I_b = I_c$

  30.10: a) $J = 1.7 \times 10^7$ A/m^2 b) $i_e = 5.3 \times 10^{18}$ s^{-1}

  30.14: $D = 1.8 \times 10^{-3}$ m

  30.16: $J = 42. \times 10^6$ A/m^2

- Office hours…

  MW 10-11 am

  TR 9-10 am

  F 12-1 pm

- Tutorial Learning Center (TLC) hours:

  MTWR 8-6 pm

  F 8-11 am, 2-5 pm

  Su 1-5 pm

Chapter 30

Current & Resistance

(*Resistance and Ohm's Law*)

Review...

- *Current density* related to the *E-field*...

$$\boxed{J = \sigma E}$$

- *Resistivity & conductivity*...

$$\boxed{\rho = \frac{1}{\sigma} = \frac{m}{n_e e^2 \tau}}$$

- *Ohm's Law*...

$$\boxed{I = \frac{\Delta V}{R}} \quad \text{where} \quad \boxed{R = \frac{\rho L}{A}}$$

Quiz Question 1

Wire 2 has *twice* the length and *twice* the diameter of wire 1. What is the ratio R_2/R_1 of their resistances?

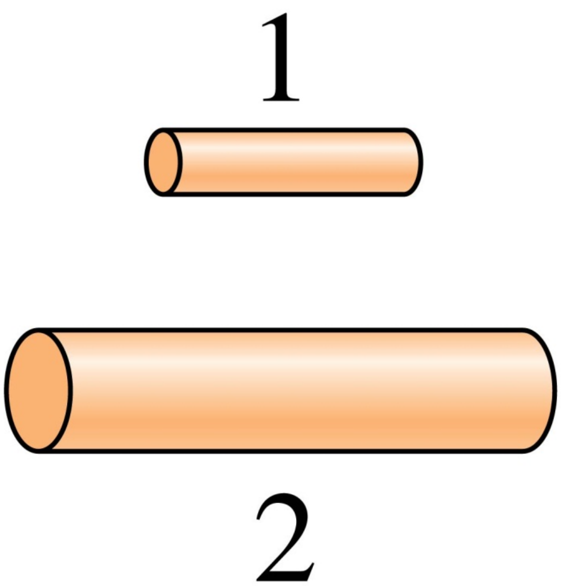
$L_2 = 2L_1$

$A_2 = 4A_1$

$R_2 = \frac{\rho L_2}{A_2}$

$R_1 = \frac{\rho 2L_1}{4A_1}$

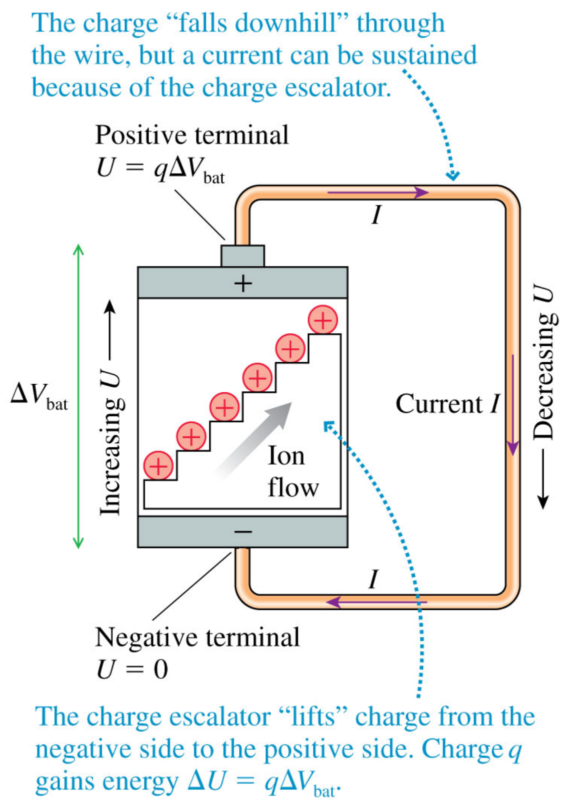
$R_1 = \frac{\rho L_1}{A_1}$



1. 1/4.
2. 1/2.
3. 1.
4. 2.
5. 4.

Resistance and Ohm's Law

- A battery is a *source* of potential difference ΔV_{bat}.
- The battery *creates* a potential difference $\Delta V_{wire} = \Delta V_{bat}$ between the ends of the wire.
- The potential difference in the wire ΔV_{wire} generates an E-field in the wire.
- The E-field establishes a current $I = JA = \sigma AE$ in the wire.
- The current in the wire is determined *jointly* by the battery and the wire's resistance, R to be:
  - $I = \Delta V_{wire}/R$

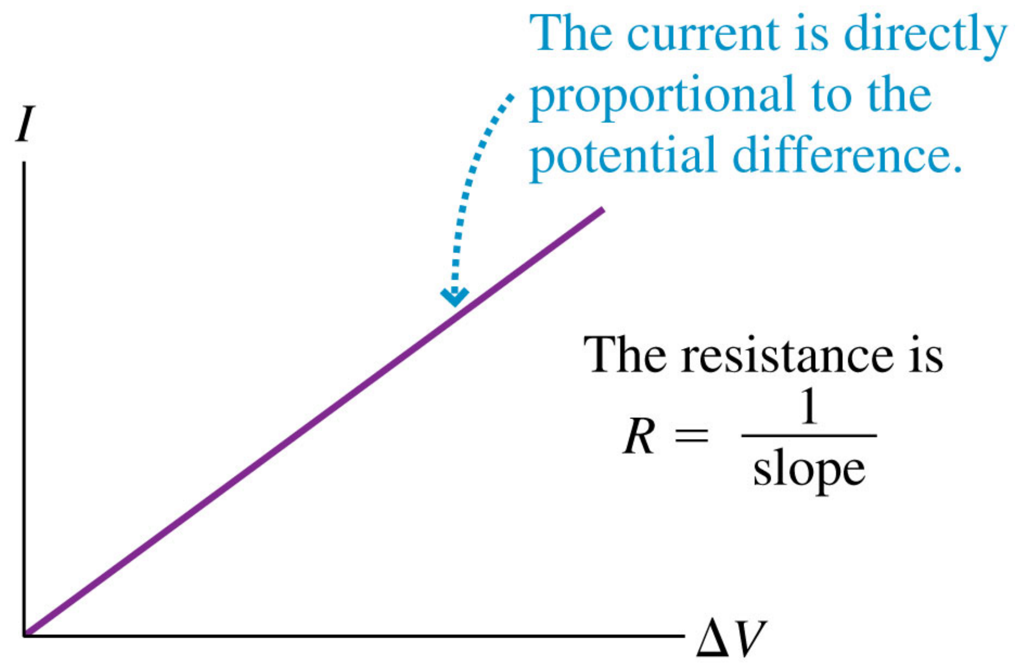


Resistance and Ohm's Law

Notice: Ohm's Law is NOT a Law!

The materials to which Ohm's law applies are called *Ohmic*.

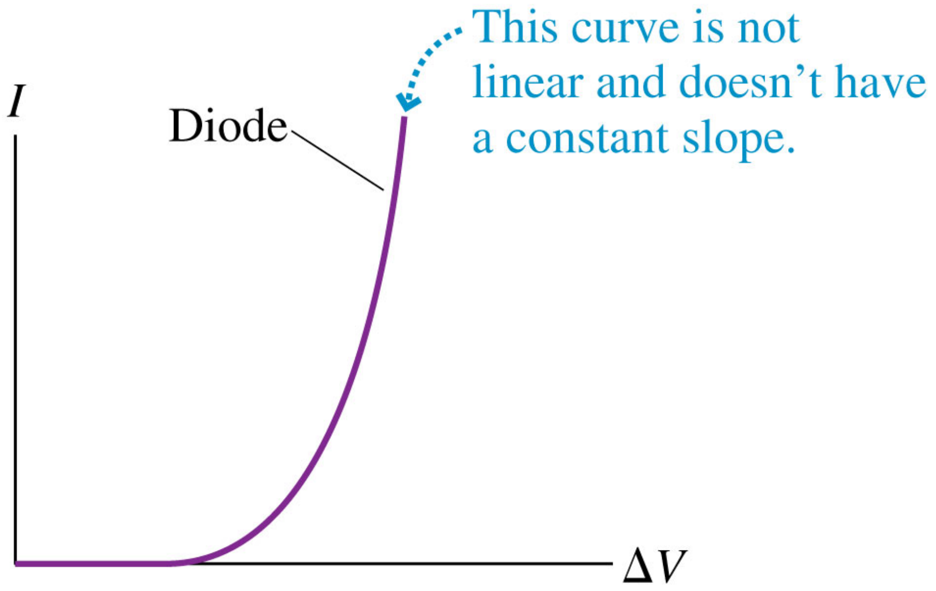
- i.e.'s: metals and conductors



Resistance and Ohm's Law

Nonohmic materials:

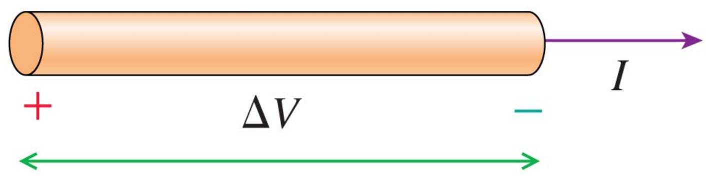
- *current*, I, through the device is *NOT* directly proportional to the *potential difference*, ΔV.
- i.e.'s: diodes, batteries, and capacitors

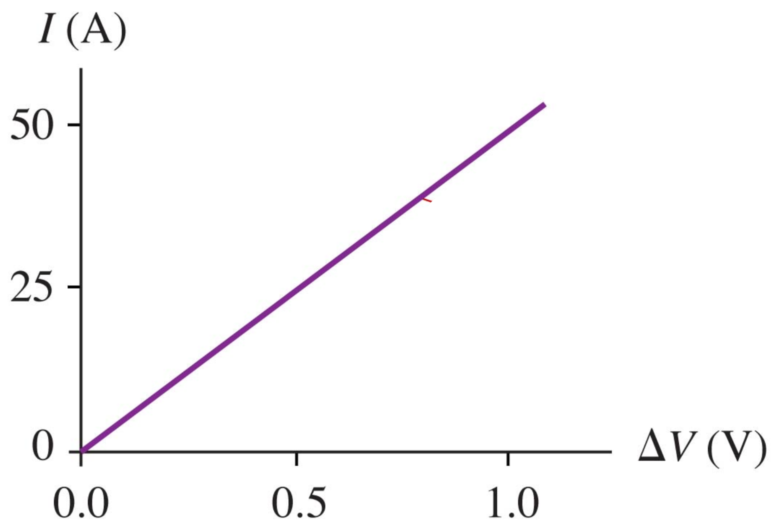


Quiz Question 2

The current through a wire is measured as the potential difference ΔV is varied.

What is the wire's resistance?

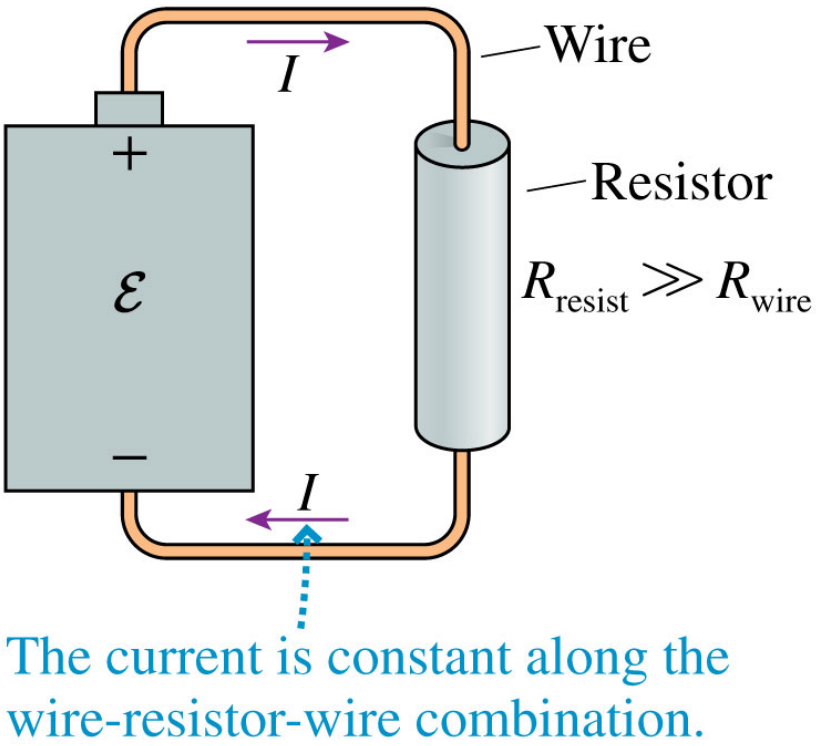




1. 0.01 Ω.
2. 0.02 Ω.
3. 50 Ω.
4. 100 Ω.
5. Some other value.

Resistance and Ohm's Law

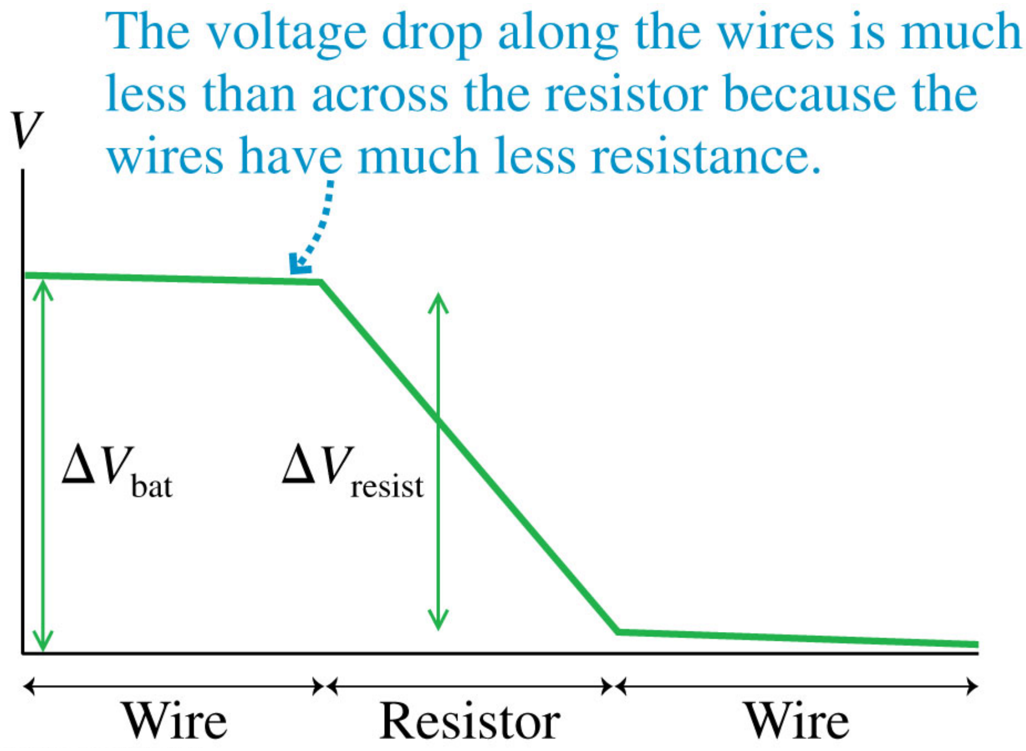
Q: How does the voltage drop across the wires compare to the voltage drop across the resistor?



Resistance and Ohm's Law

Q: How does the voltage drop across the wires compare to the voltage drop across the resistor?

A: $\Delta V_{wire} << \Delta V_{resist}$



i.e. 30.8:
A battery and a resistor

What resistor would have a 15 mA current if connected across the terminals of a 9.0 V battery?

$$I = \frac{\Delta V}{R}$$

$\Delta V = 9.0\ V$

$I = 15 \times 10^{-3} A$

$$R = \frac{\Delta V}{I}$$

$R = 600\ \Omega$